Metagenomic investigation of the RWA interventions to reduce on-farm use of antibiotics in Canadian hog barns

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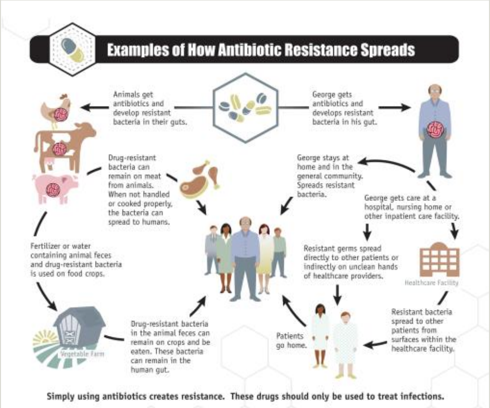
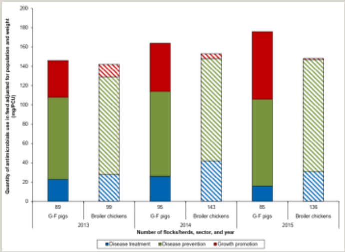
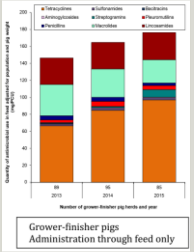
BACKGROUND & RATIONALE



CDC, 2013 AR Threats Report https://www.cdc.gov/drugresistance/biggest-threats.html

82% of total antibiotics (~1.5 10^6 kg/Yr) used in the livestock (PHAC, 2016).

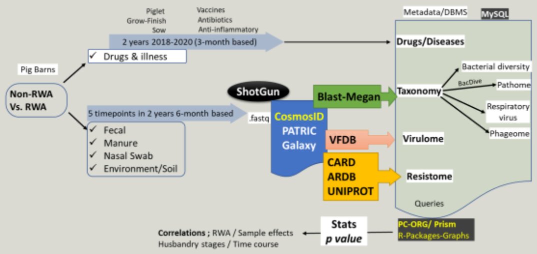




Measures to reduce AMR?

- December 2018: Antibiotics in animal under veterinary prescription.
- NOT prophylactically nor as growth promotors in feed.
- Producers implemented *Raised Without Antibiotics* (RWA) procedures.

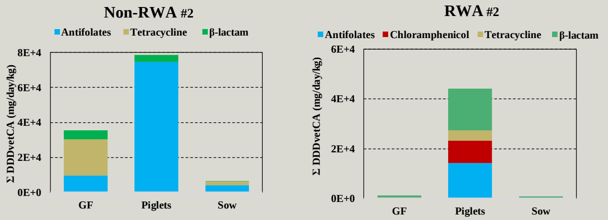
Workflow



Chekabab et al.,2020 *Computational and Structural Biotechnology Journal*

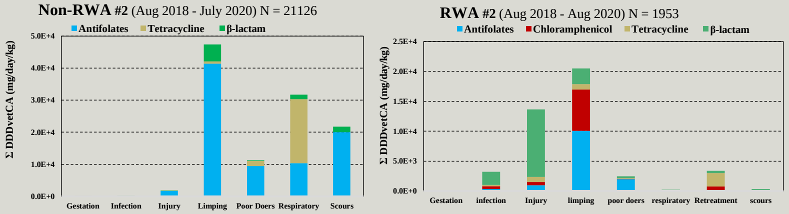
RESULTS

① Antibiotics usage / development stage.



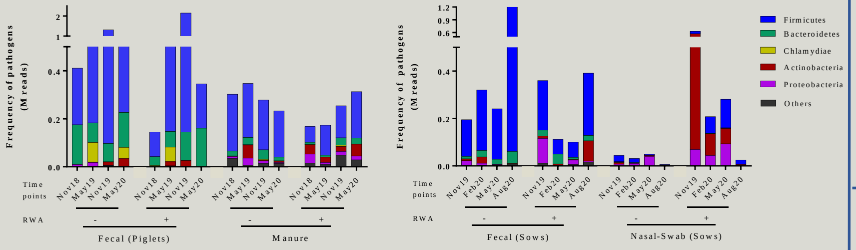
Records from 2 representative barns showing a 2.6 more-fold change (FC) of the total DDDvetCA value of all drugs administered to animals in a Non-RWA compared to RWA farm including +6FC of Antifolates, +5.2FC Tetracycline, -2FC of β-lactam.

② Antibiotics usage / treatment reason.



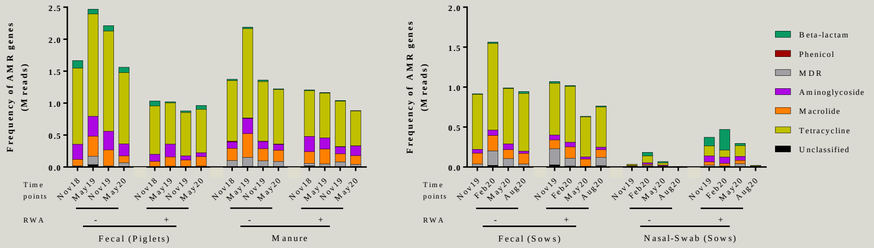
In non-RWA, animals were treated with antibiotics for Limping (41%), Respiratory (28%), Scours (19%) and Poor Doers (10%). In RWA, animals were mainly treated for Limping (47%), Injury (31%), Infection (7%) and Poor Doers (6%).

③ Pathome profiling: RWA-Sows have fewer pathogens in feces and more in Nasopharynx.



The total prevalence of pathogens are comparable between the non-RWA control and RWA barns for fecal-piglet and for the manure. However, RWA sows showed a significant decrease of pathogens in feces and an increase in the nasopharynx.

④ Metagenomic Fecal/Manure/Nasal-swabs resistomes in RWA vs. non-RWA.

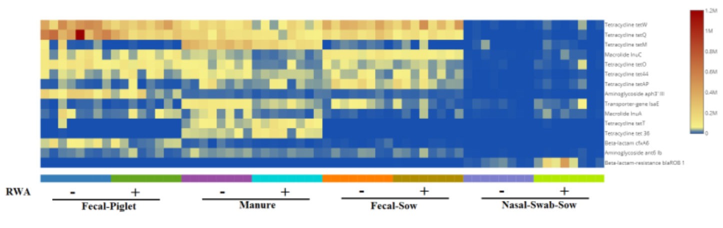


RWA significantly reduced AMR-frequency in piglet feces and in the barn's manure. In contrary, the RWA substantially increased the AMR in the sow's nasopharynx while it was slightly, but non significantly, reduced in the sow's feces.

⑤ ARGs/AMR Clustering

Heat map comparative analysis of non-RWA vs. RWA showing high frequency of the 15 most-abundant AMR taxa.

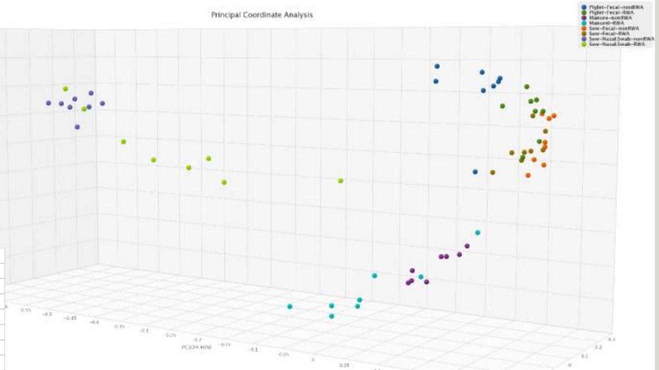
Note that resistance to tetracycline and macrolide classes was the most frequently found in fecal and manure samples, while Nasal-swabs in sows more frequently contained genes resistant to the β-lactam class.



⑥ ARGs/AMR ordination

PCA ordination significantly clustering RWA effect on the resistomes from piglet feces, manure and Sow nasopharynx ($< p$ *0.002*) but no significant effect on the sow feces resistome ($> p$ *0.1*) .

The fecal resistomes from piglets and sows are also significantly different in both RWA and non-RWA controls.



PERMANOVA Analysis	BRAY-CURTIS	
Cohorts	**P-value**	
Piglet-Fecal-nonRWA ↔ Piglet-Fecal-RWA	0.001	
Manure-nonRWA ↔ Manure-RWA	0.001	
Sow-Fecal-nonRWA ↔ Sow-Fecal-RWA	0.108	ns
Sow-Nasal.Swab-nonRWA ↔ Sow-Nasal.Swab-RWA	0.018	
Piglet-Fecal-nonRWA ↔ Sow-Fecal-nonRWA	0.001	
Piglet-Fecal-RWA ↔ Sow-Fecal-RWA	0.002	

CONCLUSIONS

Making RWA-pigs impacts overtime the prevalence of pathogens and the AMR, differently depending on the animal development-stage and on the type of sample. These promising results suggest a possibility to correlate RWA practises with variations in a specific sets of AMR classes and pathogens. This could contribute adjusting RWA measures to target a specific pig's development stages and aim to reduce AMR and pathogens persistence.

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